OBSERVATIONAL PROGRAM

FOR

AIR POLLUTION MODELS

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ABSTRACT

PIBAL winds and aircraft soundings of temperature, moisture, oxidant and particulates were gathered at several locations in the San Francisco Bay area and in the Northern Salinas Valley during the period July 31 through August 17, 1978. The observational program was conducted during MABLES WC, an extensive field study of the marine boundary layer. The design of the experiment, schedule of observations and resulting data are described in the present report. Actual data are listed in the DATA SUPPLEMENT.

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ACKNOWLEDGEMENTS

The following individuals contributed their efforts to the ARB program and to MABLES WC. South Bay Aircraft Operations: W. Brick and G. Roope (SJSU) acted respectively as observer, pilot and general program coordinators. Others involved were P. Fontana (SJSU), Charles and Judy Grubb of Garden City Aviation, and their pilots: D. Bates, T. Claspill, and J. Gonzales. North Bay Aircraft Operations: Pilots W. Burns (Coordinator), R. Gordon, S. Chaikin, H. West, and P. Roche, all of the Oceanic Society's Air Patrol. FAA Personnel from the Bay Approach Radar Services, the ATC Tower operators and FSS Personnel are cited for their extensive cooperation in routing aircraft during the course of the field program. PIBAL Observations: M. Wilson (Coordinator), F. Littell, T. Osborn, D. Berg, R. Schuster and D. Round (SJSU). Salinas cooperative PIBALS were taken by S. Crnic and T. Burnett under the supervision of H. Hillman of the Monterey Bay Unified Air Pollution Control District. Data Reduction: W. Brick, W. Jacobsen, W. Snell and A. Barnett (SJSU). Report Preparation: W. Brick, S. Frank and P. Vadney.

C. Bennett of the State Air Resources Board and L. Robinson of the Bay Area Air Quality Management District (BAAQMD) are cited for their help, advice, and encouragement during the course of the program. The success of this and other subprograms of MABLES WC was due largely to the ideas, planning and support of the late Dr. Albert Miller.

CONCLUSIONS

Aircraft sounding data and PIBAL data were collected between the surface and 10000 feet above sea level (ASL) during the period July 31, 1978 through August 17, 1978 at several locations over the northern and southern portions of the San Francisco Bay region and the northern Salinas Valley. The purpose of the study was to provide data for regional air pollution prediction models such as MASSCON. The observational period was selected so the field program would run in parallel with MABLES WC - an extensive air, land, sea study of the Marine Boundary layer. Observational and data reduction procedures have been documented in the present report. Data from aircraft soundings and PIBAL observations have been presented in tabulated form for further use. A preliminary inspection and analysis of the data indicate several occurrences of high oxidant concentrations in elevated stable layers south of Morgan Hill.

RECOMMENDATIONS

It is recommended that the data presented here be combined with other data, from MABLES WC, from conventional sources, and from the Cal-Trans automatic weather station network to investigate the processes by which pollution may be transported from the San Francisco Bay region to the northern Salinas Valley.

INTRODUCTION

An observational program, the Marine Boundary Layer Experiments, West Coast, (MABLES WC), was conducted over the ocean from the coast to 250 km west of the San Francisco Peninsula during the period July 31 through August 18, 1978. Instrumented aircraft, oceanographic research vessels, an island station and an instrumented tower were used to monitor the fluxes of momentum, energy, and mass across the boundaries of the marine layer (i.e., the layer between the ocean surface and the elevated temperature inversion).

In conjunction with MABLES WC, a series of aircraft and Pilot Balloon (PIBAL) soundings were made inland at several locations between Petaluma, north of the San Francisco Bay area, and the Hollister-Salinas area to the south. The purpose of the latter program was to supplement the extensive coastal and offshore observations of MABLES WC to provide a detailed data set for the development and verification of regional air pollution prediction models such as MASSCON . This report describes the design and execution of the inland observational program[1] and the resulting data set.

GENERAL PLAN OF OBSERVATIONS

Locations of aircraft tracks, temperature soundings, and Pilot Balloon sites for the ARB program are shown in Figure 1 together with the locations of the main observational platforms of MABLES WC. While observations at Sutro Tower and the Farallon Islands (Figure 1) began officially on July 24, 1978, the primary observational program for MABLES WC began July 31, 1978 and ran through August 17, 1978. The schedule during that period was divided into normal and 'intensive' periods. The latter were two 48-hour intervals selected on the basis of the prevailing weather conditions: August 8-9, 1978 and August 14-15, 1978. Observations of all parameters which were not already measured continuously during the normal schedule were taken at more frequent intervals during the intensive periods. The ARB program paralleled the

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[1] Referred to subsequently as the "Air Resources Board (ARB) program".

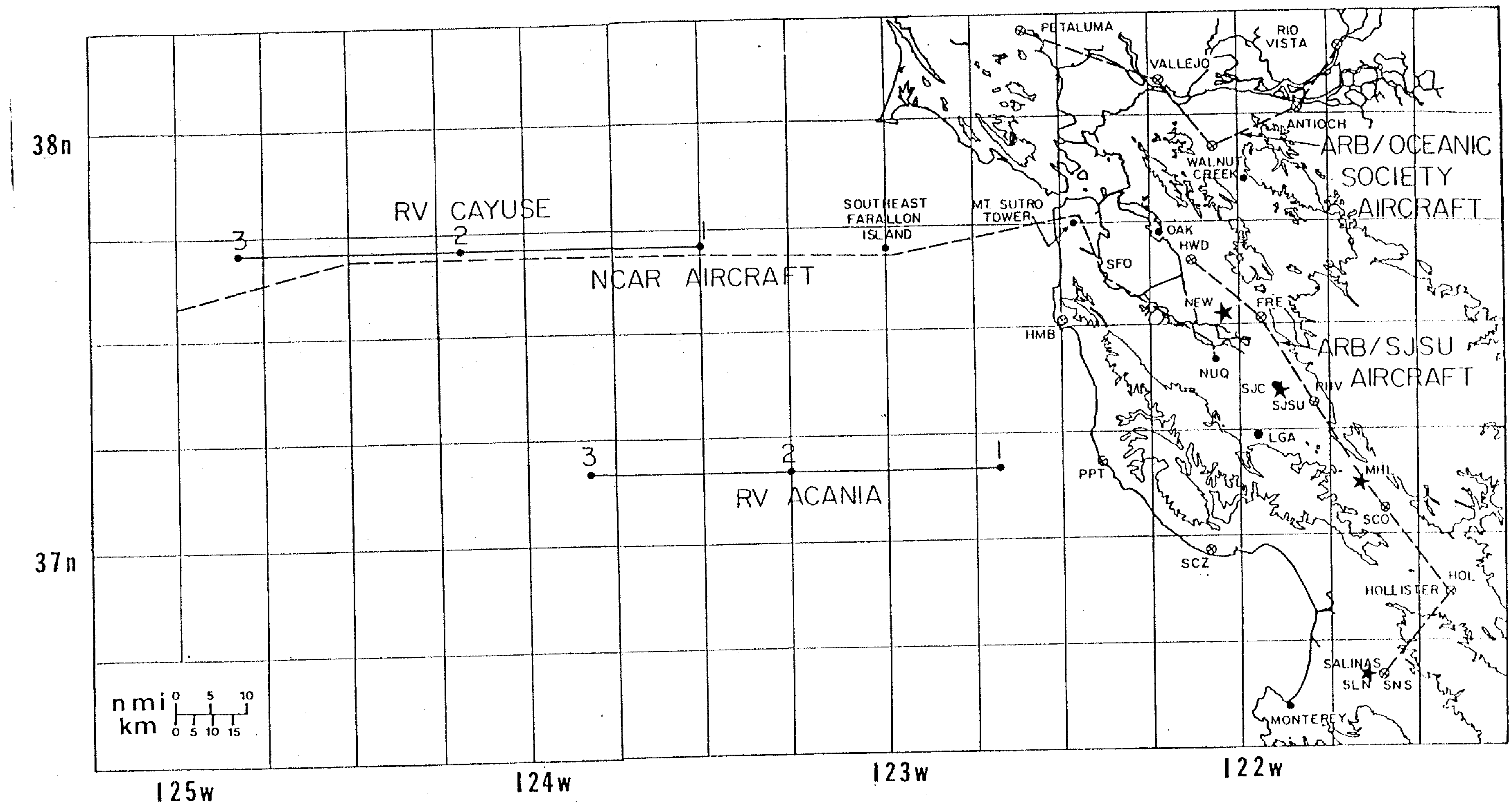

FIGURE 1. Map of operational area for MABLES WC and ARB field program. PIBAL observation sites are identified with a star and aircraft sampling locations are indicated with the letter 'x' enclosed by a circle. See Tables 2, 4 and 6 for exact locations.

schedule described above with interruptions only for equipment malfunctions and crew rest. Details are given in the following sections.

SOUTH BAY AIRCRAFT OPERATIONS

A Cherokee 235 aircraft was contracted for the period of the program and instrumented for measurements of temperature, moisture, oxidant, and particulates. Aircraft and instrument specifications are presented in Table 1. Aircraft modifications included the removal of the aircraft's rear seat for the installation of the instrument and recorder rack support, the reversal of the passenger seat for easier monitoring of the instruments, modification of the electrical system to accommodate the instrumentation, and the installation of temperature and moisture probes in the ventilation port on the leading edge of the left wing. The 1 1/2" (I.D.) air intake for the nephelometer was set in the ventilation port in the pilots (left) window. The intake was essentially ram, i.e., oriented directly into the air stream. A second intake for the oxidant monitor was set in the left wing ventilation port with the temperature and moisture probes.

Instruments were subjected to laboratory calibrations (according to manufacturers recommendations) before and after MABLES WC and prior to each flight, wherever possible. A calibration flight was also flown in formation with the instrumented Queen Air aircraft from the National Center for Atmospheric Research (NCAR) as an added check of the temperature sensors. In addition, the oxidant monitor was transported to Sacramento for calibration immediately following the field program.

The crew of the aircraft consisted the pilot, and an observer to monitor the instruments and to record pertinent visual observations during each flight. All South Bay flights originated from Reid-Hillview Airport in San Jose. Flights were ordinarily flown along the track indicated in Figure 1 with soundings at the indicated points (also see Tables 2 and 3). Aircraft soundings were conducted in ascending or descending spiral configurations at a rate of approximately 400 fpm. Ideally, the vertical extent of the soundings was surface to 8500' ASL. The time and direction of the standard flight track

TABLE 1

South Bay Aircraft and
Instrument Specifications

Aircraft 1974 Piper Model PA-28-235
Cherokee Pathfinder N40726

Wing Span	32.0 ft.
Length	24.1 ft.
Height	7.5 ft.

Ceiling: Service, 13550 feet, Absolute 15500 ft.
Cruise Speed: 153 mph
Useable Fuel: 82 gallons (15 gal $hr.^{-1}$)
Rate of Climb: 800 fpm

Instruments

Parameter	Description	Accuracy
Dry Bulb and Wet Bulb Temperatures	Pak-Tronics Model 1750-201 Sensors 1164/1192. Range: -30C to 50C (dual input)	±1.0C
Oxidants	Dasibi Model 1003AH Ultraviolet Ozone Monitor	±1.0%
Particulates	MRI System 2050 Integrating Nephelometer	±10%

TABLE 2

South Bay Aircraft Sounding Locations

Location	Altitude (Ft. MSL)	Latitude North	Longitude West	Remarks
Hayward Airport (HWD)	47	$37^{\circ}40'$	$122^{\circ}07'$	HWD has an Air Traffic Control Tower. Therefore, there were deviations of up to 1.5 km from center of airport. These deviations generally occurred in the airport traffic area (surface up to but not including 3000 ft Agl).
Fremont Airport (FRE)	04	$37^{\circ}27'$	$121^{\circ}55'$	Soundings done approximately 7.5 km north over Mission San Jose (Sunol Pass). At times soundings were limited to 5000' MSL due to jet traffic.
Reid-Hillview Airport (RHV)	133	$37^{\circ}19'$	$121^{\circ}49'$	RHV has an Air Traffic Control Tower. Deviations of up to 1.5 km from center of airport occurred in airport traffic area. Deviations in Ascent/Descent rates also occurred in last 1000' at times.
South County Airport (SCO)	281	$37^{\circ}04'$	$121^{\circ}35'$	Deviations of up to 1.5 km.
Hollister Airport (HOL)	233	$36^{\circ}53'$	$121^{\circ}24'$	Deviations of up to 1.5 km.
Salinas Airport (SNS)	84	$36^{\circ}39'$	$121^{\circ}36'$	SNS has an Air Traffic Control Tower. Deviations of up to 1.5 km. For soundings when airport covered with Stratus, Middle-Marker of Instrument Landing System (ILS) was used for reference.
<u>Non-Standard Sounding Locations</u>:				
Half-Moon Bay Airport (HMB)	64	$37^{\circ}31'$	$122^{\circ}30'$	Deviations up to 1.5 km.
Pigeon Point (PPT)	sea level	$37^{\circ}11'$	$122^{\circ}23'$	Deviations up to 1.5 km.
Santa Cruz (West) (SCZ)	sea level	$36^{\circ}57'$	$122^{\circ}05'$	Deviations up to 1.5 km.
Los Gatos Area (LGA)	500	$37^{\circ}15'$	$121^{\circ}55'$	Deviations up to 3 km.

TABLE 3

South Bay Aircraft Time Table

Date (1978)	Flight #	Take-off Time (PST)	Landing Time (PST)	Sounding Locations: (In chronological Order, an asterisk indicates an ascent). 1	2	3	4	5	6	Remarks
7-31				NO	FLIGHTS					Propeller repair
8- 1				NO	FLIGHTS					"
2				NO	FLIGHTS					"
3	1	1327	1648	RHV*	SNS	HOL	HWD	FRE*		
4	2	0815	1131	SNS	HOL	RHV	FRE*	HWD		
4	3	1624	1922	SNS	HOL	SCO*	RHV	FRE*		
5				NO	FLIGHTS					Crew rest
6				NO	FLIGHTS					Crew rest
7	4	0519	0840	RHV*	SCO	SNS*	SCZ	PPT*	HMB	Diverted flight (coast)
7	5	1351	1705	RHV*	HWD	FRE*	SCO	HOL*	SNS	
7	6	1923	2222	HWD	FRE*	RHV	SCO*	HOL	SNS	
8	7	0830	1140	RHV*	HWD	FRE*	SCO	HOL*	SNS*	
8	8	1610	1941	RHV*	HWD	FRE*	SCO	HOL*	SNS	
9	9	0519	0842	SNS	HOL*	SCO	RHV*	FRE	HWD*	
9	10	1118	1443	RHV*	SNS	HOL*	SCO	FRE*	HWD	
9	11	1630	1939	RHV*	SNS	HOL*	SCO	FRE*	HWD	
10	12	0519	0850	RHV*	HWD	FRE*	SCO	HOL*	SNS	
10	13	1128	1452	RHV*	HWD	FRE*	SCO	HOL*	SNS	
10	14	1609	1931	RHV*	HWD	FRE*	SCO	HOL*	SNS	
11	15	0506	0822	RHV*	SNS	HOL*	SCO	FRE*	HWD	
11	16	1438	1647	SNS*	HOL	SCO*	RHV			
11	17	1843	2153	SNS*	HOL	SCO*	HWD	FRE*	RHV	
12				NO	FLIGHTS					Crew rest
13	18	0637	0855	RHV*	SCO	HOL*	SNS			NCAR Aircraft Rendevous
13	19	1109	1358	RHV*	HWD	FRE*	SCO	HOL*	SNS	
14	20	0508	0811	SNS	HOL*	SCO	RHV*	FRE		
14	21	1050	1100							Alternator burned out
14	22	1434	1802	SNS*	HOL	SCO*	RHV	FRE*	HWD	
15	23	0514	0905	HWD	FRE*	RHV	SCO*	HOL		
15	24	1141	1433	FRE*	RHV	SCO*	HOL	SNS*		
15	25	1608	1904	RHV*	HWD	FRE*	SCO	HOL*		
16	26	1630	1950	SNS*	HOL	SCO*	RHV	FRE		
17	27	0603	0911	HOL	FRE					Chased high O_x readings
17	28	1500	1730	SCO	HOL*	LGA				Chased high O_x readings
18	SAC	0710		FRE*						Delivered oxidant monitor to ARB, Sacramento, for calibration.

(north-south or south-north) were varied in an attempt to isolate the normal diurnal variations of the profiles of temperature, moisture and pollutants.

Deviations from these standard procedures occured for four reasons: (1) to monitor pollutants along the coast in offshore flow, (2) to reenter layers of apparently high oxidant concentrations, (3) because of instrument or aircraft malfunction, and (4) because of low ceilings and/or visibilities (e.g., soundings were often terminated above the tops of the stratus clouds over Salinas).

PIBAL OBSERVATIONS

Single theodolite observations were taken during the field program at sites near Newark, San Jose, Morgan Hill and Salinas[2]. Exact locations of the sites are given in Table 4. When visibility and ceiling height allowed, PIBALS were launched from the first three sites four times daily during the normal schedule (04, 10, 16, 22 PST) and six times daily during the two intensive periods (00, 04, 08, 12, 16, 20 PST). The cooperative Salinas station took PIBALS on the same schedule whenever weather and workload allowed. Standard tracking methods for 30 gram balloons were used. All readings were made at 30 second intervals. Dates and times of PIBAL observations are shown in Table 5.

NORTH BAY AIRCRAFT OPERATIONS

Ten aircraft flights (approximately 30 hours) were flown by members of the Oceanic Society's Air Patrol in the North Bay area. Each flight consisted of five spiral soundings between 7000' ASL and as near the surface (or cloudtop) as allowable under VFR conditions. Light aircraft (e.g., Cessna 182) were used to gather altitude, temperature, and pertinent visual observations at 500 feet intervals. Temperatures were either measured with a portable thermistor-type[3] or with the standard outside air temperature (Scott) thermometer with which the aircraft were equipped. Locations of the North Bay aircraft soundings are shown in Figure 1 and listed in Table 6. The flight schedule is given in Table 7.

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[2]The Salinas observations were made in cooperation with the Monterey Bay Unified Air Pollution Control District office in that city.

[3]Provided by the Bay Area Air Quality Management District (Y.S.I. probe).

TABLE 4

PIBAL Station Location

Station		Latitude	Longitude	Altitude (FT. ASL)
Newark (Golf Course)	(NEW)	37°32'	122°03'	20
San Jose (SJSU)	(SJS)	37°20'	121°52'	210
Morgan Hill (CDF)*	(MHL)	37°07'	121°38'	320
Salinas (MBUAPCD)	(SLN)	36°42'	121°38'	108

*California Department of Forestry

TABLE 5

Pilot Balloon Observations Schedule

Site	Date (1978)	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
												Time (PST)													
Newark	7-31											X						X						X	
	8-01					X						X						X						X	
	02											X						X					X		
	03											X						X						X	
	04					X						X						X						X	
	05								REST DAY																
	06								REST DAY																
	07					X						X						X						X	
	08					X						X						X						X	
	09					X				X				X				X				X			
	10	X									X			X				X				X			
	11	X										X						X						X	
	12								REST DAY																
	13					X						X						X						X	
	14					X				X				X				X				X			
	15	X				X				X				X				X				X			
	16	X										X						X						X	
	17					X	X	X	X	X															
SJSU	7-31																	X						X	
	01					X						X						X						X	
	02					X						X						X						X	
	03					X						X						X							
	04					X						X						X						X	
	05								REST DAY																
	06								REST DAY																
	07					X						X						X						X	
	08					X						X						X						X	
	09					X				X					X			X				X			
	10	X				X					X			X				X				X			
	11	X										X						X							X
	12								REST DAY																
	13					X						X						X						X	
	14					X				X				X				X				X			
	15	X				X				X				X				X				X			
	16	X										X						X						X	
	17					X	X	X	X	X	X	X													

TABLE 5 (CONTINUED)

Pilot Balloon Observations Schedule

Site	Date (1978)	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Morgan Hill	7-31											X						X							
	8-01					X						X						X							X
	02					X						X						X						X	
	03											X						X						X	
	04					X						X						X						X	
	05									REST DAY															
	06									REST DAY															
	07					X						X							X					X	
	08					X						X						X							X
	09					X				X				X				X				X			
	10	X				X				X				X				X				X			
	11	X										X						X						X	
	12									REST DAY															
	13												X					X						X	
	14					X				X				X				X				X			
	15		X			X				X				X				X				X			
	16											X						X							X
	17					X		X	X	X	X	X													
Salinas	7-31																	X							
	8-01											X													
	02																								
	03												X					X							
	04											X						X							
	05									REST DAY															
	06									REST DAY															
	07											X						X							
	08											X						X							
	09										X			X				X							
	10																								
	11											X							X						
	12									REST DAY															
	13																								
	14									X				X				X							
	15										X			X											
	16																	X							
	17											X						X						X	
	18											X						X							

TABLE 6

North Bay Aircraft Sounding Locations

Location	Altitude (Ft. ASL)	Latitude N	Longitude W	Remarks
Petaluma Airport (PTA)	79	$38^{o}15'$	$122^{o}36'$	Deviations up to 2.5 km
Vallejo (VLO)	200	$38^{o}06'$	$122^{o}13'$	Deviations up to 2.5 km
Walnut Creek (WCK)	250	$37^{o}50'$	$122^{o}02'$	Deviations up to 3 km
Antioch Airport (ATH)	180	$37^{o}58'$	$121^{o}48'$	Deviations up to 1.5 km
Rio Vista Airport (RVA)	45	$38^{o}10'$	$121^{o}41'$	Deviations up to 3 km

TABLE 7

North Bay Aircraft Flight Schedule

Date (1978)	Flight Number	Take-off Time (PST)	Landing Time (PST)	Locations in Chronological Order 1	2	3	4	5	Remarks
7-31									No Flight
8-1									No Flight
2									No Flight
3									No Flight
4									No Flight
5									No Flight
6									No Flight
7									No Flight
8									No Flight
9	1	0515		RVA	ATH	WCK	VLO	PTA	YSI Thermistor
9	2	1109		RVA	ATH	WCK	VLO	PTA	YSI Thermistor
9	3	1552		PTA	VLO	WCK	ATH	RVA	YSI Thermistor
10									No Flight
11									No Flight
12									No Flight
13	4	0812		RVA	ATH	WCK	VLO	PTA	Scott Thermometer
13	5	1622		RVA	ATH	WCK	VLO	PTA	Scott Thermometer
14	6	0411		RVA	ATH	WCK	VLO	PTA	Scott Thermometer
14	7	1045		RVA	ATH	WCK	VLO	PTA	Scott Thermometer
15	8	0845	1220	RVA	ATH	WCK	VLO	PTA	Scott Thermometer
15	9	1600		PTA	VLO	RVA	ATH	WCK	Scott Thermometer
16	10	1612		RVA	ATH	WCK	VLO	PTA	YSI Thermistor
17									No Flight
18									No Flight

DATA REDUCTION

Dry and wet bulb temperature data for the South Bay aircraft were corrected for dynamic heating affects. Preflight and postflight calibrations and the calibration flight with the NCAR aircraft indicated that no other corrections were necessary. A similar correction was not applied to the Oceanic Society's North Bay aircraft because less control was possible on aircraft, speed, altitude, thermometer type and placement (at 100 knots, a full ram effect will cause a temperature probe to sense a temperature about 1°C too high). All data are point values either recorded directly or taken from the strip charts at the reported level. Oxidant data were corrected for altitude in the standard manner[4]. Tabulated data from north and south bay aircraft and PIBAL data from all sites have been available to ARB in the Data Supplement to this report.

During some of the flights, especially in the Salinas-Hollister area, several anomolously high oxidant values were recorded. Since these values, which occasionally exceeded 0.5 PPM, appeared to be due to contamination or instrument error[5], the following procedures were initiated to resolve the problem: (1) towards the end of the program, (see Table 3) the aircrew was instructed to attempt to reenter any layers of apparently high oxidant concentration to verify their existence, (2) the crew was instructed to draw bag samples in regions of high oxidant concentration for later analysis and (3) the oxidant monitor was delivered to the ARB laboratories in Sacramento immediately following the field program for calibration.

It was found that the high values of oxidant were repeatable on several (but not all) soundings when the aircraft returned to the same layer. Very few bag samples were drawn and those obtained were not collected in the most extreme cases; the results were inconclusive. The ARB calibration of the oxidant monitor showed it to be accurate within about three percent. Finally, an examination of the data indicated that on several occasions the layers with anomolous oxidant values showed apparent horizontal continuity, appearing in soundings taken within 20 miles at about the same altitude.

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[4]The measured value was multiplied by the ratio of sea level pressure to flight level pressure (standard atmosphere).

[5]Neither the pilot or observer reported the acrid smell of Ozone usually noticeable at the concentrations detected.

These results suggest that a contamination of some type existed. Communications with Air Resources Board personnel produced the following list of possibilities: (1) aromatic hydrocarbons, (2) sunlight, and (3) particulates. Item (1) could not be checked because of insufficient bag samples; item (2) has been suggested by Kauper (1978), although the apparent horizontal and vertical repeatability of high values at different times on the same flight casts some doubt on this explanation.[6] Item (3) appears to be a likely answer since the intake system for the oxidant sample was not filtered. It should be noted, however, that this particular sampling system has been used on other occasions with no problems. In the tabulated aircraft soundings (see Data Supplement), all oxidant values exceeding 0.25 PPM have been arbitrarily flagged as suspect. The flagged values account for only about 1.0% of the entire sample.

DISCUSSION

The large sample of data collected by aircraft and from PIBAL sites during the period July 31 to August 17, 1978 provides detailed meteorological information suitable for the development and verification of regional air pollution prediction models. In addition, the data also provide the basis for several potentially illuminating diagnostic studies. For example, a preliminary examination of the aircraft data has shown several occurrences of elevated layers of oxidant south of Morgan Hill. Such a finding is relevant to the problem of possible pollution transport from the San Francisco Bay Region to the Monterey Bay area. It will be useful to illustrate some of the types of analyses which can be performed on the present data, and at the same time, to document one of the high oxidant episodes. Figures 2 and 3 show, respectively, the temperature and oxidant distributions in a vertical cross section from Hayward (HWD) to Hollister (HOL) for late afternoon and early evening on August 9, 1978. Note that in the future, these analyses can be extended by incorporating data from other locations such as Salinas (ARB program), Monterey (USNPGS), Oakland (NWS), and Sutro Tower (SJS).

The major points of interest in the cross sections are (1) the well-defined elevated temperature inversion, (2) the apparent mesoscale front north of RHV, (3) the maximum height of the inversion base at SCO, (4) the minimum

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[6] Note the DASIBI Model 1003AH used in this study is identical to that used by Kauper (1978).

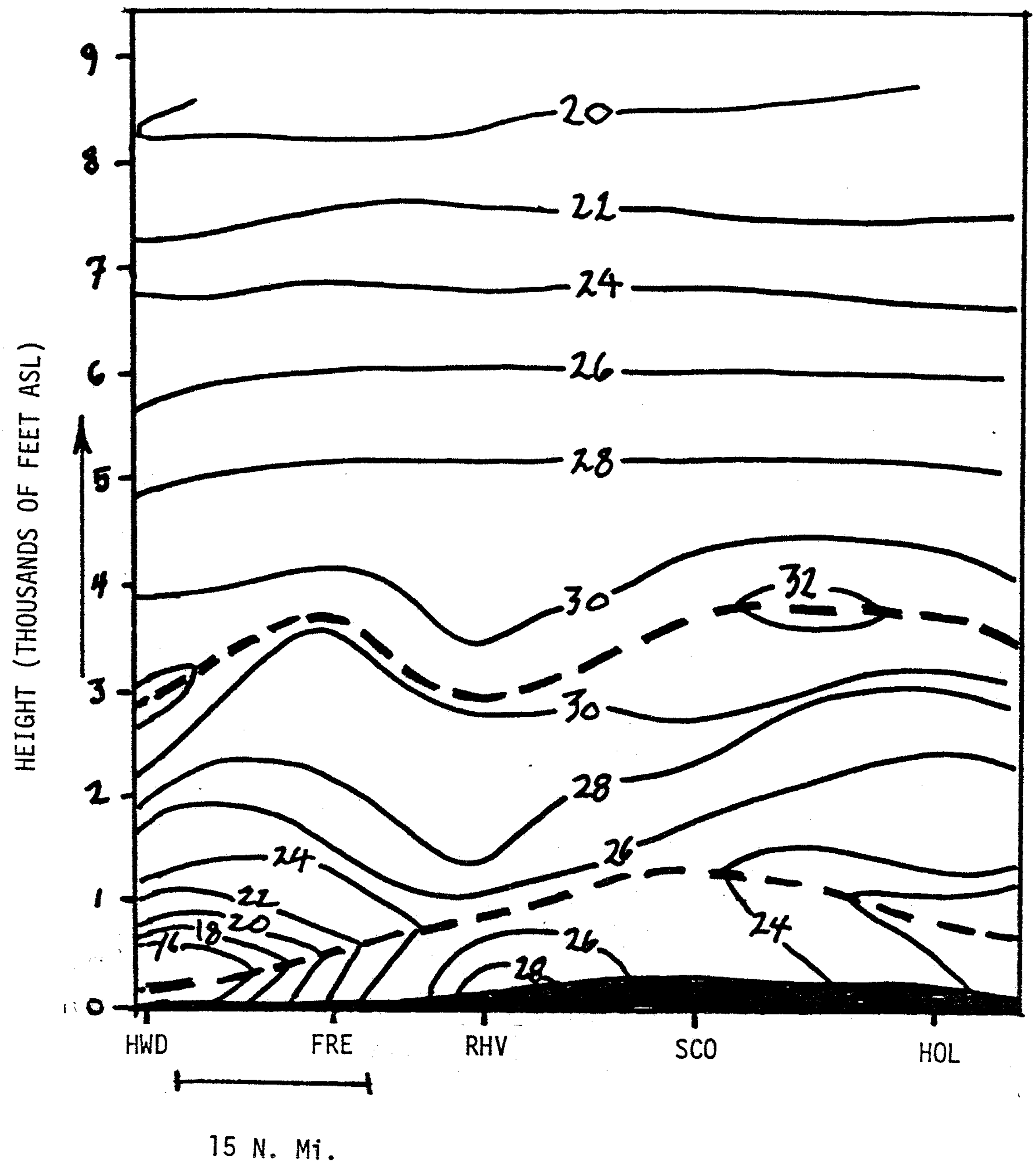

FIGURE 2. Vertical section of temperature (^{o}C) for August 9, 1978, based on the 1630-1939 PST aircraft flight. Station locations are given in Figure 1 and Table 2. The heavy dashed lines denote the boundaries of the marine inversion. Note strong horizontal temperature gradient corresponding with a low level mesoscale front to the left (North) of RHV.

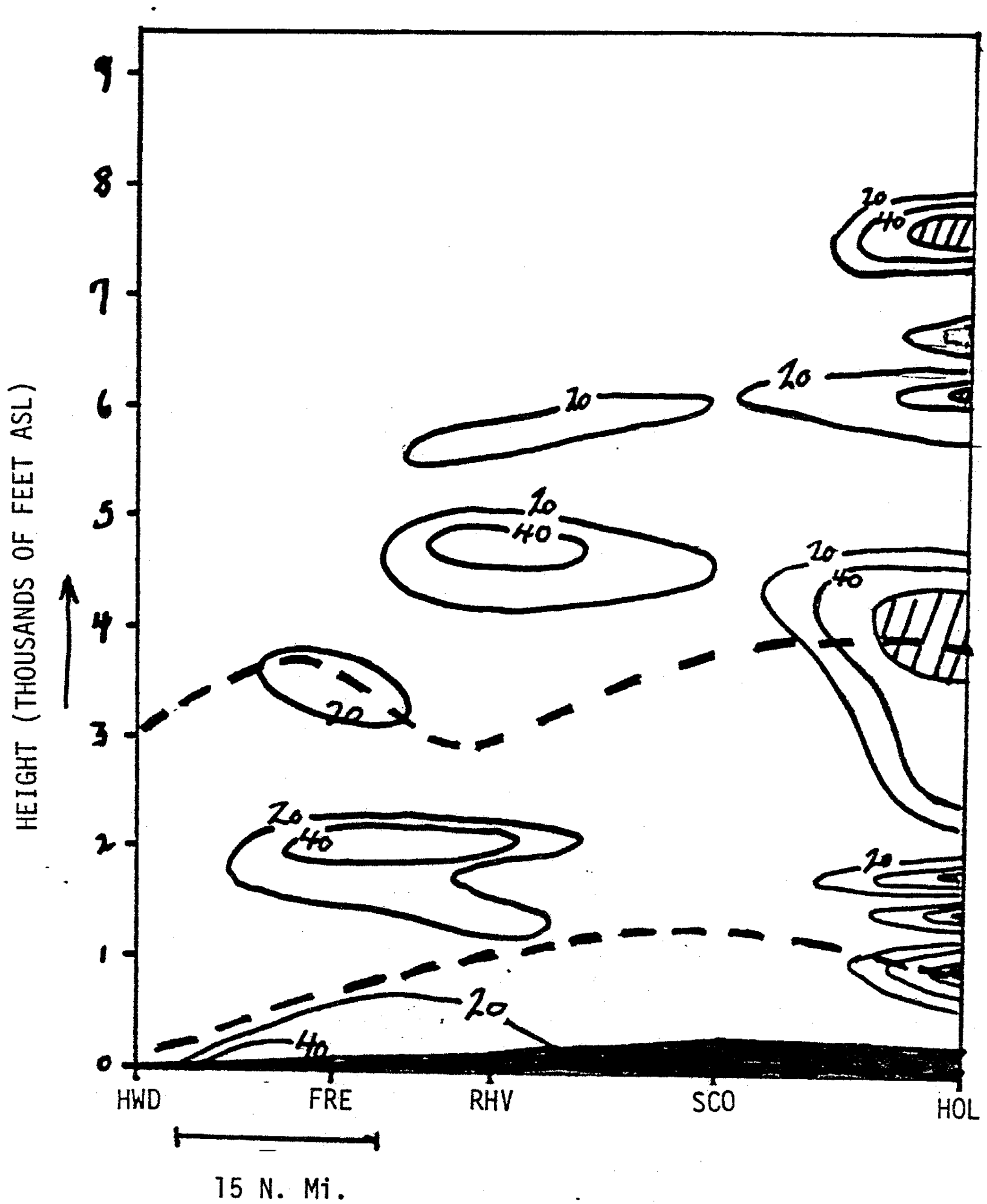

FIGURE 3. Same as Figure 2, but for oxidant concentration. Isopleths are drawn for 20, 40 and 100 PPB. Areas with concentrations exceeding 100 PPB are shaded. The heavy dashed lines correspond with the boundaries of the marine inversion as shown in Figure 2.

height of the top of the inversion at RHV, and (5) the elevated layers with high oxidant concentrations, within and above the inversion, especially near HOL. The aircraft observer noted a "yellow-brown" haze layer in the vicinity of the oxidant maximum in the center of the inversion. The polluted layer also appeared visually and in the oxidant measurements over Salinas during the same flight. The dip in the inversion top over RHV corresponded to a relatively dry layer centered just above the inversion top at that location. The secondary oxidant maximum (20-40 PPB) at lower levels near FRE is apparently associated with the marine air north of the mesoscale front.

PIBAL winds for 2100 PST (not shown) indicated that a convergence zone was present south of the frontal position in Figure 2. Winds below the inversion were NNW at SJSU and SE at MHL, while at the top of the inversion, winds were everywhere NNW.

These preliminary analyses raise some important questions: e.g., What is the source of the high oxidant concentrations in the elevated layers in the Hollister region? How frequently do such layers occur? How are the layers affected by the seabreeze circulations and by the thermally-induced circulations which occur along the sides of the valleys where the inversion is likely to be weaker? Answers to these questions are pertinent to understanding the north-south transport of pollution. It follows that the data presented here should be analyzed in greater detail, together with supplemental information from MABLES WC, conventional meteorological data, and the data from the Cal-Trans automatic surface weather station network.